

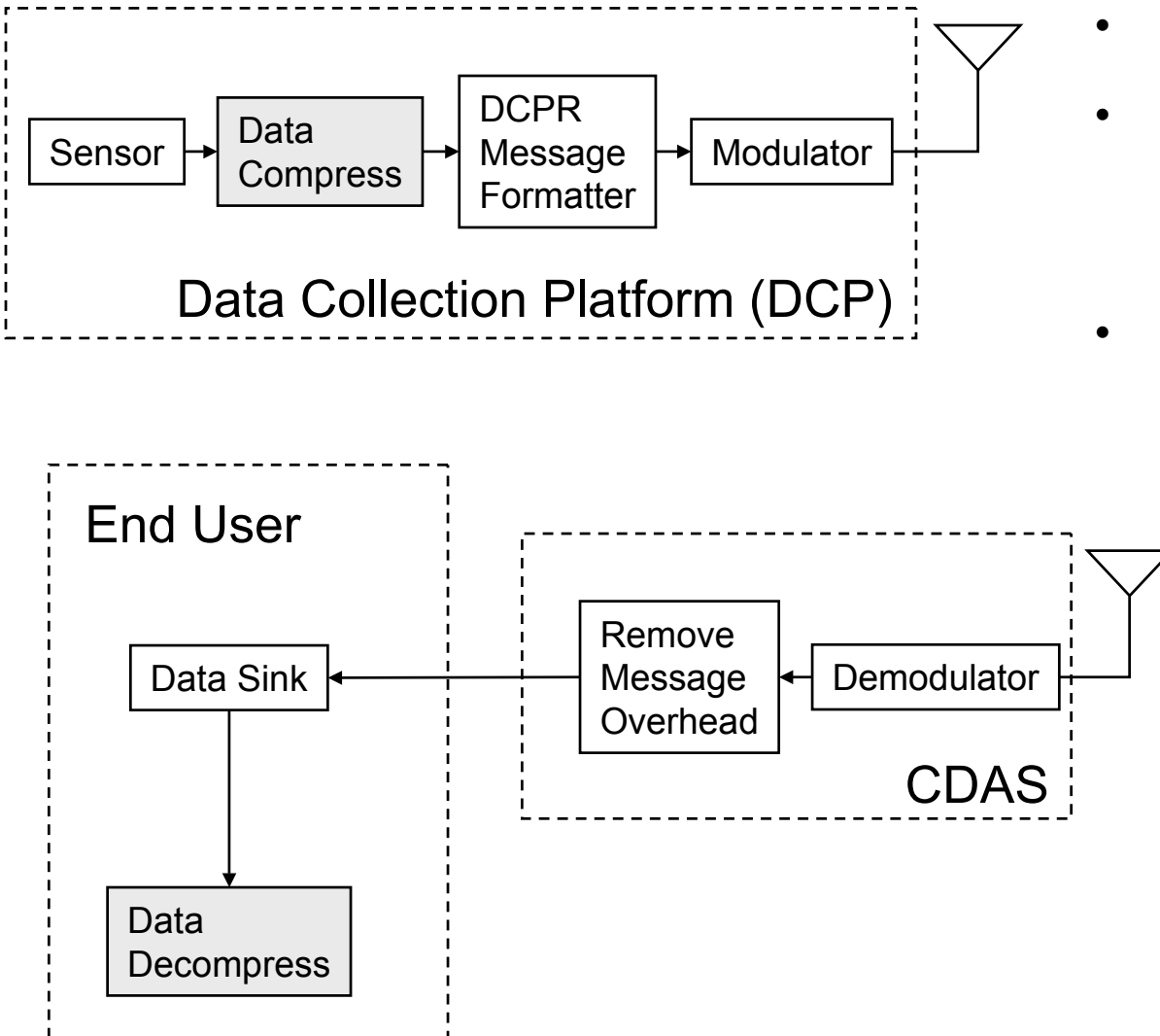


Lossless Data Compression

- Goal
 - Determine whether lossless data compression will be useful on the DCPR communications link
- Rationale
 - Lossless data compression may be able to reduce the amount of transmission time associated with each DCPR message
 - Overall result would be to increase the capacity of the DCPR communications system as more DCPs would be able to be supported
 - Implementation conceivably be done without modification to CDAS
- Considerations
 - Actual DCPR messages may not be well suited for compression
 - Compression ratios may turn out to be small
 - If DCPR messages compress well, error propagation may be an issue
- Comments
 - Compression ratios (ie gains due to compression) and error propagation are a function of the nature of the data, lossless compression technique employed, and length of the message
 - Many lossless compression techniques available



Where would compression fit?



- Compression would be performed on data collected from sensor
- Compression and/or decompression could be performed in software or hardware
 - COTS hardware compression ICs are available today
- Compression flag in Flag word of DCPR message set to 0 for DCPs that don't support compression
 - Compression bit already in current flag word of DCPR message overhead

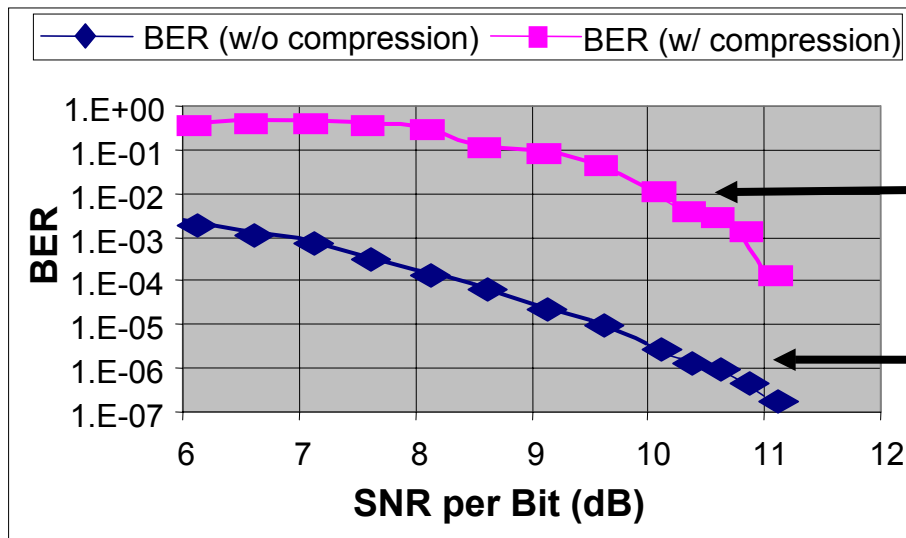


Error Propagation

- Description: single bit errors in compressed data stream result in multiple bit errors when the compressed data stream is decompressed
- Impact of error propagation from lossless data compression function of the following:
 - Nature of the data
 - For data that compresses only marginally, error propagation probably less significant
 - Type of lossless compression scheme employed
 - Different schemes are more or less robust to phenomenon
- Error propagation not a concern for many data communications applications such as the Internet, when compression is employed
 - Automatic Repeat Request (ARQ) or equivalent typically employed.
- DCPR doesn't have an ARQ channel available
 - Error propagation, therefore, potential issue



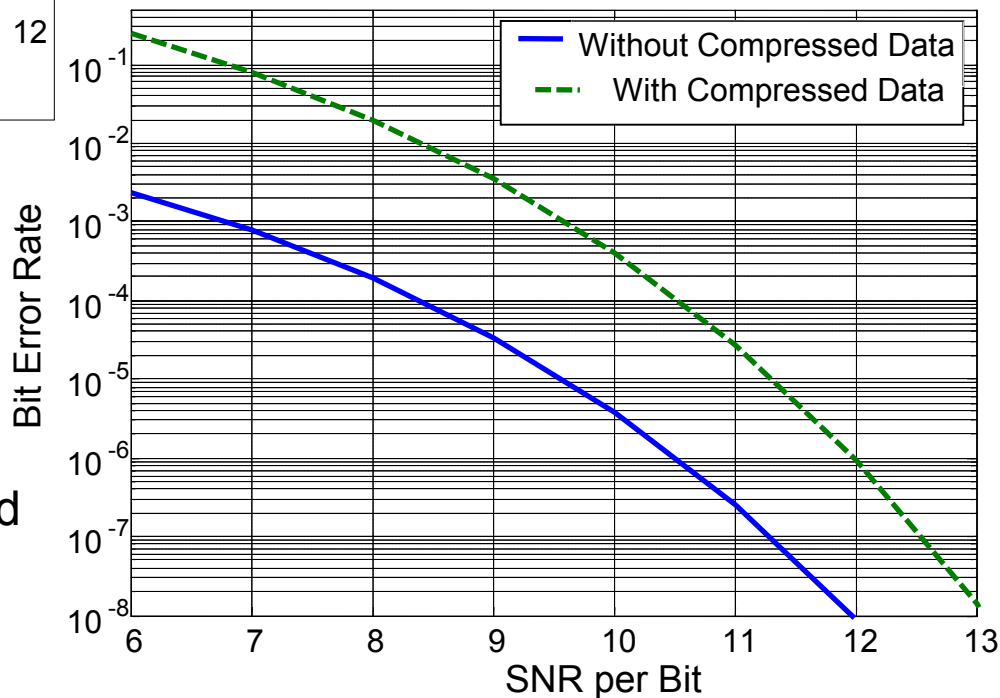
Error Propagation Impacts BER



BER of compressed data stream after uncompression

BER of uncompressed data stream

Simulated Results using Actual DCPR messages



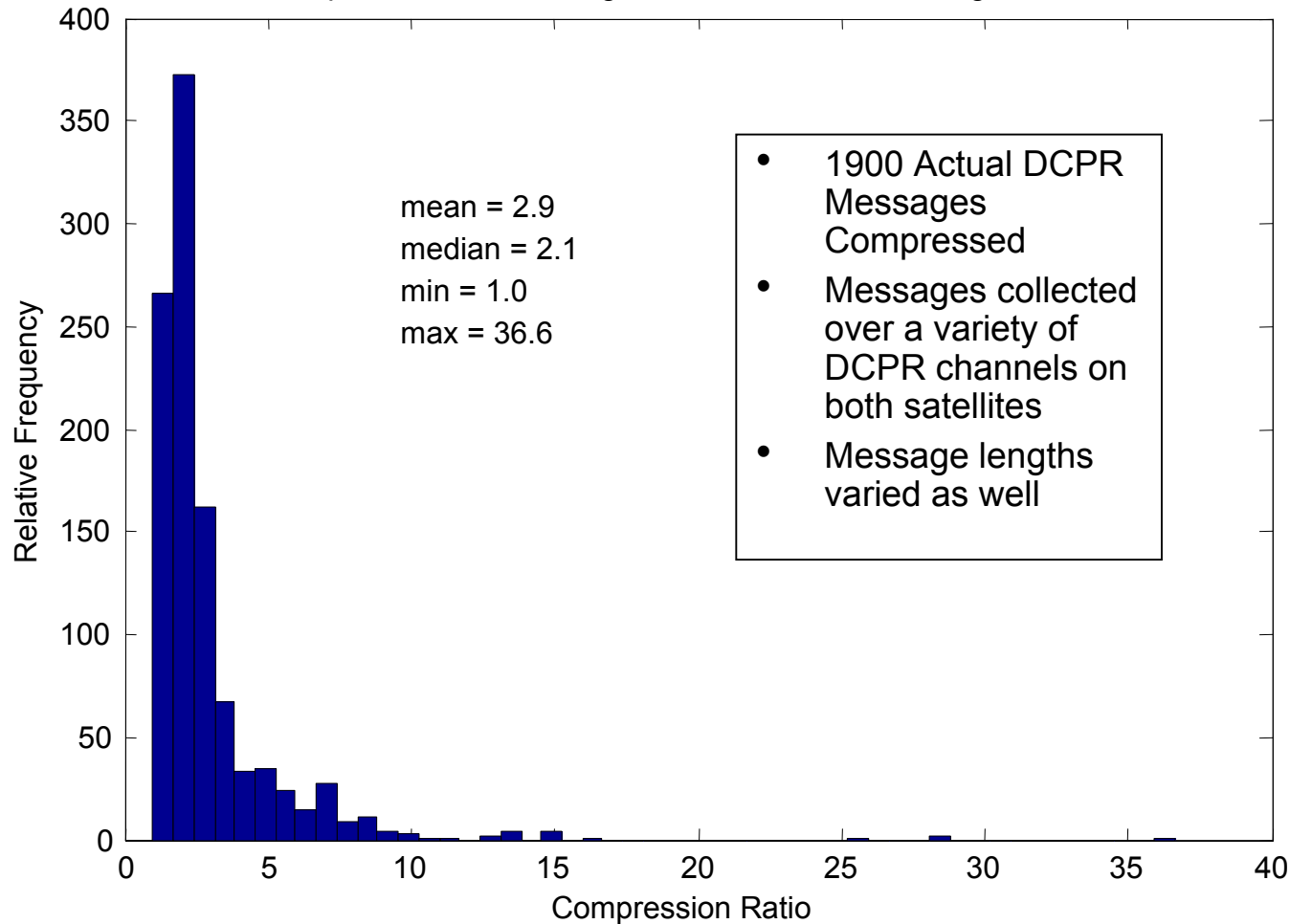
Calculated Curve

BPSK example illustrated



GNU Zip Compression Results

Compression Ratio Histogram -- 1900 DCPR Messages



- GNU Zip freely distributable compression software
- Compatible with and similar to WinZip



Compression Considerations

- Widely varying compression ratios of actual DCPR messages make utilizing compression gains difficult in current DCPR system
 - Not possible to simply shorten every DCP transmission time by a factor of the average compression ratio, since some messages don't compress and can't have transmission time shortened
 - DCPs may not necessarily send messages that always compress by a factor of two or more
- Error propagation
 - Requires some amount of FEC coding be added
 - 7/8 rate convolutional code would provide needed gain while adding modest overhead (< 15%).
 - Adds some additional amount of complexity to DCP and receiver, however